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Gary K. Michelson

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THREADED FRUSTO-CONICAL INTERBODY

SPINAL FUSION IMPLANTS

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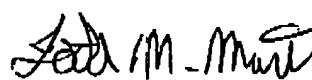
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in place, said surface roughenings being present on at least a portion of said outer surface of said implant.

51. The spinal fusion implant of claim 50 in which said surface roughenings include a plurality of ratchetings.

52. The spinal fusion implant of claim 50 in which said surface roughenings include knurling.

53. The spinal fusion implant of claim 32 in which said implant has an internal chamber and an access opening for accessing said internal chamber.

54. The spinal fusion implant of claim 53 in which said internal chamber is capable of containing fusion promoting material.

55. The spinal fusion implant of claim 53 in which said implant comprises a wall surrounding said internal chamber.

56. The spinal fusion implant of claim 53 in which said wall has a plurality of openings passing therethrough in communication with said internal chamber.

57. The spinal fusion implant of claim 53 in which said implant has means for closing said access opening.

58. The spinal fusion implant of claim 32 in which one of said ends of said implant includes an engagement means for engaging instrumentation for the insertion of said implant.

59. The spinal fusion implant of claim 32 in which at least a portion of said outer surface comprises wells having at least partial walls.

60. The spinal fusion implant of claim 32 in which said implant is configured to be placed in close proximity in a side by side alignment to a second spinal fusion implant, said first and second implants when placed together having a combined overall width that is less than the sum of the individual maximum diameters of each of said first and second implants.

61. The spinal fusion implant of claim 32 having a longitudinal central axis and at least one truncated side forming a planar surface parallel to said central axis.

62. The spinal fusion implant of claim 61 in which said external thread has a thread height measured from said body which is greatest at said truncated side.

63. A frusto-conical interbody spinal fusion implant, comprising:  
a body having a substantially frusto-conical configuration, an insertion end, a trailing end and an outer surface; and

bone engaging means for engaging said implant to adjacent vertebrae of the spine, the outer locus of said bone engaging means forming a substantially frusto-conical configuration, said implant being made of a material appropriate for human implantation.

64. The spinal fusion implant of claim 63 in which said trailing end is larger than said insertion end.

65. The spinal fusion implant of claim 63 in which said insertion end is larger than said trailing end.

66. The spinal fusion implant of claim 63 in which said implant comprises a bone ingrowth material.

67. The spinal fusion implant of claim 63 in which said implant comprises a fusion promoting material.

68. The spinal fusion implant of claim 63 in which said implant is at least in part bioabsorbable

69. The spinal fusion implant of claim 63 having a plurality of openings capable retaining fusion promoting material.

70. The spinal fusion implant of claim 63 in which said bone engaging means comprises an external thread.

71. The spinal fusion implant of claim 70 in which said external thread has a thread radius measured from the longitudinal central axis of said implant, said thread radius being substantially uniform throughout at least a portion of said implant.

72. The spinal fusion implant of claim 70 in which said external thread has a thread radius measured from the longitudinal central axis of said implant, said thread radius being variable along the length of said implant.

73. The spinal fusion implant of claim 70 in which said external thread has a thread height measured from said body which is variable along the length of said implant.

74. The spinal fusion implant of claim 70 in which said external thread has a thread height measured from said body which is substantially constant along the length of said implant.

75. The spinal fusion implant of claim 63 in which said bone

engaging means comprises said outer surface being porous at least in part.

76. The spinal fusion implant of claim 63 in which said bone engaging means comprises a plurality of posts spaced apart along at least a portion of the outer surface of said body.

77. The spinal fusion implant of claim 76 in which said plurality of posts have a head portion and a stem portion, said head portion having a wider diameter than said stem portion.

78. The spinal fusion implant of claim 63 in which said bone engaging means comprises a mesh-like material having a plurality of interstices for receiving fusion promoting material.

79. The spinal fusion implant of claim 63 in which said bone engaging means includes a plurality of surface roughenings for engaging said adjacent vertebrae and for maintaining said implant in place, said surface roughenings being present on at least a portion of said outer surface of said implant.

80. The spinal fusion implant of claim 79 in which said surface roughenings include a plurality of ratchetings.

81. The spinal fusion implant of claim 79 in which said surface roughenings include knurling.

82. The spinal fusion implant of claim 63 in which said implant has an internal chamber and an access opening for accessing said internal chamber.

83. The spinal fusion implant of claim 82 in which said internal

chamber is capable of containing fusion promoting material.

84. The spinal fusion implant of claim 82 in which said implant comprises a wall surrounding said internal chamber.

85. The spinal fusion implant of claim 82 in which said wall has a plurality of openings passing therethrough in communication with said internal chamber.

86. The spinal fusion implant of claim 82 in which said implant has means for closing said access opening.

87. The spinal fusion implant of claim 63 in which one of said ends of said implant includes an engagement means for engaging instrumentation for the insertion of said implant.

88. The spinal fusion implant of claim 63 in which at least a portion of said outer surface comprises wells having at least partial walls.

89. The spinal fusion implant of claim 63 in which said implant is configured to be placed in close proximity in a side by side alignment to a second spinal fusion implant, said first and second implants when placed together having a combined overall width that is less than the sum of the individual maximum diameters of each of said first and second implants.

90. The spinal fusion implant of claim 63 having a longitudinal central axis and at least one truncated side forming a planar surface parallel to said central axis.

91. The spinal fusion implant of claim 90 in which said external thread has a thread height measured from said body which is

greatest at said truncated side.

92. An interbody spinal fusion implant, comprising:

a body having a substantially cylindrical configuration, an insertion end, a trailing end and an outer surface; and

bone engaging means for engaging said implant to adjacent vertebrae of the spine, the locus of said bone engaging means forming a substantially cylindrical configuration, said implant being made of a material appropriate for human implantation.

93. The spinal fusion implant of claim 92 in which said implant comprises a bone ingrowth material.

94. The spinal fusion implant of claim 92 in which said implant comprises a fusion promoting material.

95. The spinal fusion implant of claim 92 in which said implant is at least in part bioabsorbable

96. The spinal fusion implant of claim 92 having a plurality of openings capable retaining fusion promoting material.

97. The spinal fusion implant of claim 93 in which said bone engaging means comprises an external thread.

98. The spinal fusion implant of claim 97 in which said external thread has a thread radius measured from the longitudinal central axis of said implant, said thread radius being substantially uniform for at least a portion of said implant.

99. The spinal fusion implant of claim 97 in which said external thread has a thread radius measured from the longitudinal central

axis of said implant, said thread radius being variable along at least a portion of said implant.

100. The spinal fusion implant of claim 97 in which said external thread has a thread height measured from said body which is variable along at least a portion of said implant.

101. The spinal fusion implant of claim 97 in which said external thread has a thread height measured from said body which is substantially constant along the length of said implant.

102. The spinal fusion implant of claim 93 in which said bone engaging means comprises said outer surface being porous at least in part.

103. The spinal fusion implant of claim 93 in which said bone engaging means comprises a plurality of posts spaced apart along at least a portion of the outer surface of said body.

104. The spinal fusion implant of claim 103 in which said plurality of posts have a head portion and a stem portion, said head portion having a wider diameter than said stem portion.

105. The spinal fusion implant of claim 93 in which said bone engaging means comprises a mesh-like material having a plurality of interstices for receiving fusion promoting material.

106. The spinal fusion implant of claim 93 in which said bone engaging means includes a plurality of surface roughenings for engaging said adjacent vertebrae and for maintaining said implant in place, said surface roughenings being present on at least a portion of said outer surface of said implant.

107. The spinal fusion implant of claim 106 in which said surface roughenings include a plurality of ratchetings.

108. The spinal fusion implant of claim 106 in which said surface roughenings include knurling.

109. The spinal fusion implant of claim 93 in which said implant has an internal chamber and an access opening for accessing said internal chamber.

110. The spinal fusion implant of claim 109 in which said internal chamber is capable of containing fusion promoting material.

111. The spinal fusion implant of claim 109 in which said implant comprises a wall surrounding said internal chamber.

112. The spinal fusion implant of claim 109 in which said wall has a plurality of openings passing therethrough in communication with said internal chamber.

113. The spinal fusion implant of claim 109 in which said implant has means for closing said access opening.

114. The spinal fusion implant of claim 93 in which one of said ends of said implant includes an engagement means for engaging instrumentation for the insertion of said implant.

115. The spinal fusion implant of claim 93 in which at least a portion of said outer surface comprises wells having at least partial walls.

116. The spinal fusion implant of claim 93 in which said implant is configured to be placed in close proximity in a side by side alignment to a second spinal fusion implant, said first and second implants when placed together having a combined overall width that is less than the sum of the individual maximum diameters of each of said first and second implants.

117. The spinal fusion implant of claim 93 having a longitudinal central axis and at least one truncated side forming a planar surface parallel to said central axis.

118. The spinal fusion implant of claim 117 in which said external thread has a thread height measured from said body which is greatest at said truncated side.

119. A frusto-conical interbody spinal fusion implant, comprising:  
a body having a substantially frusto-conical configuration, an insertion end, a trailing end and an outer surface; and

bone engaging means for engaging said implant to adjacent vertebrae of the spine, said implant being made of a material appropriate for human implantation.

120. The implant of claim 119 in which the outer locus of said bone engaging means forms a substantially frusto-conical configuration.

121. The implant of claim 119 in which said the outer locus of said bone engaging means forms a substantially cylindrical configuration.

122. The spinal fusion implant of claim 119 in which said insertion end is larger than said trailing end.

123. The spinal fusion implant of claim 122 in which said insertion end comprises a tapered leading portion.

124. The spinal fusion implant of claim 119 in which said trailing end is larger than said insertion end.

125. The spinal fusion implant of claim 119 in which said implant comprises a bone ingrowth material.

126. The spinal fusion implant of claim 119 in which said implant comprises a fusion promoting material.

127. The spinal fusion implant of claim 119 in which said implant is at least in part bioabsorbable

128. The spinal fusion implant of claim 119 having a plurality of openings capable retaining fusion promoting material.

129. The spinal fusion implant of claim 119 in which said bone engaging means comprises an external thread.

130. The spinal fusion implant of claim 129 in which said external thread has a thread radius measured from the longitudinal central axis of said implant, said thread radius being substantially uniform throughout the length of said implant.

131. The spinal fusion implant of claim 129 in which said external thread has a thread radius measured from the longitudinal central axis of said implant, said thread radius being variable along the length of said implant.

132. The spinal fusion implant of claim 129 in which said external

thread has a thread height measured from said body which is variable along the length of said implant.

133. The spinal fusion implant of claim 129 in which said external thread has a thread height measured from said body which is substantially constant along the length of said implant.

134. The spinal fusion implant of claim 119 in which said bone engaging means comprises said outer surface being porous at least in part.

135. The spinal fusion implant of claim 119 in which said bone engaging means comprises a plurality of posts spaced apart along at least a portion of the outer surface of said body.

136. The spinal fusion implant of claim 135 in which said plurality of posts have a head portion and a stem portion, said head portion having a wider diameter than said stem portion.

137. The spinal fusion implant of claim 119 in which said bone engaging means comprises a mesh-like material having a plurality of interstices for receiving fusion promoting material.

138. The spinal fusion implant of claim 119 in which said bone engaging means includes a plurality of surface roughenings for engaging said adjacent vertebrae and for maintaining said implant in place, said surface roughenings being present on at least a portion of said outer surface of said implant.

139. The spinal fusion implant of claim 138 in which said surface roughenings include a plurality of ratchetings.

140. The spinal fusion implant of claim 138 in which said surface roughenings include knurling.

141. The spinal fusion implant of claim 119 in which said implant has an internal chamber and an access opening for accessing said internal chamber.

142. The spinal fusion implant of claim 141 in which said internal chamber is capable of containing fusion promoting material.

143. The spinal fusion implant of claim 141 in which said implant comprises a wall surrounding said internal chamber.

144. The spinal fusion implant of claim 141 in which said wall has a plurality of openings passing therethrough in communication with said internal chamber.

145. The spinal fusion implant of claim 141 in which said implant has means for closing said access opening.

146. The spinal fusion implant of claim 119 in which one of said ends of said implant includes an engagement means for engaging instrumentation for the insertion of said implant.

147. The spinal fusion implant of claim 119 in which at least a portion of said outer surface comprises wells having at least partial walls.

148. The spinal fusion implant of claim 119 in which said implant is configured to be placed in close proximity in a side by side alignment to a second spinal fusion implant, said first and second implants when placed together having a combined overall width that is less than the sum of the individual maximum diameters of each of

said first and second implants.

149. The spinal fusion implant of claim 119 having a longitudinal central axis and at least one truncated side forming a planar surface parallel to said central axis.

150. The spinal fusion implant of claim 149 in which said external thread has a thread height measured from said body which is greatest at said truncated side.

151. A method for inserting at least one frusto-conical spinal fusion implant made of a material appropriate for human implantation, said implant having bone engaging means for engaging the adjacent vertebrae in a segment of the spinal column, comprising the steps of:

distracting the two vertebrae adjacent the diseased disc and placing the two vertebrae in the desired amount of lordosis;

drilling a frusto-conical recipient bore across the disc space and into the adjacent vertebrae, said bore being at least in part greater in diameter than the disc space height such that some bone is removed from each of the adjacent vertebrae; and

inserting a frusto-conical spinal fusion implant into said recipient bore.

152. The method claim 151 in which said bore is greatest in diameter anteriorly and tapering to a lesser diameter posteriorly.

153. The method claim 151 in which said bore is greatest in diameter posteriorly and tapering to a lesser diameter anteriorly.

154. The method of claim 151 in which said step of drilling

includes the use of a drill having a substantially frusto-conical shaped bone removing means.

155. The method of claim 151 in which a second spinal fusion is implanted across the disc space engaging each of the adjacent vertebrae side by side and adjacent to said first spinal fusion implant.

156. The method of claim 155 comprising the step of drilling a second recipient bore across the disc space partially overlapping said first bore, the combined width of said first and second recipient bores being less than the sum of the individual diameters of said first and second recipient bores; and inserting a second spinal fusion implant.

157. The method of claim 151 in which said method is performed from the anterior aspect of the spinal column.

158. The method of claim 151 in which said method is performed from the posterior aspect of the spinal column.

159. The method of claim 151 in which the step of drilling said recipient bore includes the removal of a portion of bone parallel to the endplates of said adjacent vertebrae.

160. A method for inserting at least one frusto-conical spinal fusion implant made of a material appropriate for human implantation, said implant having bone engaging means for engaging the adjacent vertebrae in a segment of the spinal column, comprising the steps of:

distracting the two vertebrae adjacent the diseased disc;

drilling a recipient bore across the disc space and into the

adjacent vertebrae, said bore being at least in part greater in diameter than the disc space height such that some bone is removed from each of the adjacent vertebrae; and

inserting a frusto-conical spinal fusion implant into said recipient bore.

161. The method of claim 160 in which said recipient bore is generally cylindrical in shape.

162. The method of claim 160 in which said step of drilling includes the use of a drill having a substantially cylindrical shaped bone removing means.

163. The method of claim 160 in which a second spinal fusion is implanted across the disc space engaging each of the adjacent vertebrae side by side and adjacent to said first spinal fusion implant.

164. The method of claim 163 comprising the step of drilling a second recipient bore across the disc space partially overlapping said first bore, the combined width of said first and second recipient bores being less than the sum of the individual diameters of said first and second recipient bores; and inserting a second spinal fusion implant.

165. The method of claim 160 in which said method is performed from the anterior aspect of the spinal column.

166. The method of claim 160 in which said method is performed from the posterior aspect of the spinal column.

167. The method of claim 160 in which the step of drilling said

recipient bore includes the removal of a portion of bone parallel to the endplates of said adjacent vertebrae.

ABSTRACT

The present invention is directed to a variety of interbody spinal fusion implants having at least a partially frusto-conical configuration and the instrumentation and methods by which the implants of the present invention can be utilized to achieve a desired anatomical lordosis of the spine. The spinal fusion implants of the present invention may be relatively solid or hollow and may have surface roughenings to promote bone ingrowth and stability. The spinal fusion implants of the present invention may have wells extending into the material of the implant from the surface for the purpose of holding fusion promoting materials and to provide for areas of bone ingrowth fixation. A variety of surface irregularities may be employed to increase implant stability and implant surface area, and/or for the purpose of advancing the spinal fusion implant into the fusion site.